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December 17, 2010

Reference No. 038443-89

Ms. Karen Cibulskis
Remedial Project Manager
United States Environmental Protection Agency
Region V
77 West Jackson Boulevard
Mail Code SR-6J
Chicago, IL 60604

Dear Ms. Cibulskis:

Re: Vapor Intrusion (VI) Investigation Work Plan (Work Plan)
South Dayton Dump and Landfill Site Moraine, Ohio (Site)

As required under the Dispute Resolution Agreement signed by the Respondents and USEPA on December 10, 2010, this Work Plan presents the proposed approach for a VI Study to investigate sub-slab soil vapor conditions beneath buildings on particular Site parcels and adjacent to the Site. The VI Study will be completed as an interim response action pursuant to Paragraph 37(c) of the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (RI/FS) of the Site, Docket No. V-W-06-C-852 (ASAOC). Conestoga-Rovers & Associates (CRA) has prepared this Work Plan on behalf of the Respondents to the ASAOC (Respondents).

The work proposed in this Work Plan will be performed in accordance with the United States Environmental Protection Agency- (USEPA-) approved Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Site-Specific Health and Safety Plan (HASP), and associated addenda that are submitted as attachments to this Work Plan.

This Work Plan is presented in the following titled sections:

1.0 Background
2.0 VI Study
3.0 Schedule
4.0 Reporting

1.0 BACKGROUND

The Respondents to the ASAOC include Hobart Corporation (Hobart), Kelsey Hayes Company (Kelsey-Hayes), and NCR Corporation (NCR). These three Respondents (the PRP Group) are and have been performing the Work required by the ASAOC under the direction and oversight of the USEPA.

The investigation of the Site has documented elevated concentrations of methane, naphthalene, and volatile organic compounds (VOCs) in landfill gas. There are a number of operating businesses located on the Site, above or immediately adjacent to fill material and in close proximity to the soil gas probe locations where elevated levels of VOCs and methane were detected. By a letter dated October 5, 2010, USEPA had directed Respondents to submit a work plan for a VI Study to address the risks from VI to residents and businesses in buildings on and adjacent to the Site.

VI is the migration of volatile chemicals from the subsurface into overlying buildings. VI is a potential concern at any building, existing or planned, located near soil or groundwater contaminated with toxic chemicals that can volatilize.

Under the December 10, 2010 Dispute Resolution Agreement the Respondents and USEPA agreed that the Respondents will complete the VI Study to assess the potential for methane, VOCs, and naphthalene in soil vapor to result in potential risks to receptors in buildings on and adjacent to the Site.

Specifically, the Dispute Resolution Agreement states:

> [T]*he Respondents shall conduct the VI Study, as required by EPA, pursuant to Paragraph 37 (c) of the ASAOC, as an interim response action. EPA has given the Group a copy of the newly issued EPA Region 5 Vapor Intrusion Guidebook (Guidebook) and the Parties have agreed that the Respondents will prepare their VI Work Plan, which will include Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) Addenda, in accordance with this new guidance and other relevant guidance (e.g., FSP and QAPP guidance). The Parties agree that the Work Plan will provide for sub-slab sampling, on an expedited schedule of any of the following structures which are of slab-on-grade construction or have basements or enclosed crawl spaces (see highlighted structures on Figure* [1], *attached, for an illustration of the structures for which sub-slab sampling is anticipated):*

A. Structures On Site West of Dryden Road:
3 building structures on Lot 5054
3 building structures on Lot 5171
2 building structures on Lot 5172
1 building structure on Lot 5174
1 building structure on Lot 5175, and

B. Structures On Site or Adjacent to Site Along East River Road:
4 building structures on Lot 4610 (Barnett; on-Site)
2 building structures on Lot 3207
1 residence on Lot 3253; and
1 building structure on Lot 3254.

Any additional structures on the Site that are, or may be, occupied will be evaluated to determine the need for VI sampling.

The Parties agree that if any structure on or adjacent to the Site that is or may be occupied has no slab (e.g., dirt or gravel floor) that Respondents will take indoor air samples (see Section 6.6 of Guidebook).

The Parties agree that the Respondents shall submit a Work Plan for the VI Study required by EPA by December 17, 2010. The Parties agree that if identified contaminant concentrations pose more than a 1×10^{-4} cancer risk or a hazard index greater than 1.0 through the VI pathway to current or potential future receptors, or if VI sampling results show an exceedance of 10% of the Lower Explosive Limit, EPA may require actions to mitigate those risks.

The PRP Group has prepared this Work Plan based on requirements of the Dispute Resolution Agreement, previous investigation results and discussions between the PRP Group and USEPA.

2.0 VI STUDY

CRA will complete a sub-slab soil vapor quality investigation beneath the existing on-Site structures and certain structures adjacent to the Site as described in Section 1.0 above. CRA will install and sample the sub-slab soil vapor probes in accordance with CRA's SOPs for installing sub-slab probes and collecting sub-slab soil vapor samples presented in Attachment A, which is an addendum to the FSP.

For any of the structures listed above and any additional structures evaluated that are or may be occupied but do not have a concrete slab floor (e.g., dirt or gravel floor), CRA will collect indoor air samples within the structure. The standard operating procedure (SOP) for the Indoor

Air Sampling is provided in Attachment B (addendum to the FSP). For any location where an indoor air sample is collected, CRA will also install a soil vapor probe screened between 3 and 5 feet below ground surface in accordance with CRA's SOP (Appendix J-F-11 of the FSP) in order to attempt to correlate indoor air concentrations to concentrations of contaminants in soil vapor near the structure. The soil vapor probes will be installed immediately adjacent to the side of the building closest to the most likely source of any soil vapor impacts. CRA will agree on the proposed soil vapor probe locations with USEPA prior to their installation. CRA will collect a soil vapor sample from any newly installed soil vapor probe, and submit the sample(s) for analysis of VOCs by USEPA's TO-15 methodology[1]. In addition, where indoor air samples are collected, CRA will also collect ambient air samples immediately adjacent to the structure as per CRA's SOP. Sub-slab soil vapor and indoor air sampling activities are summarized in Attachment C (addendum to the QAPP).

CRA has prepared this scope of work for the sub-slab soil vapor sampling in accordance with the following vapor intrusion guidance documents:

- Office of Solid Waste and Emergency Response (OSWER) - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), November 2002 (USEPA, 2002)
- Interstate Technology Regulatory Council (ITRC) - Vapor Intrusion Pathway: A Practical Guide, January 2007 (ITRC, 2007)
- United States Environmental Protection Agency (USEPA) – Region 5 - Vapor Intrusion Guidebook, October 2010 (USEPA, 2010)

The purpose of the VI Investigation is to collect additional data to determine if compounds are volatilizing into soil vapor beneath the building foundations and floor slabs at concentrations that are sufficiently high that contaminants could potentially migrate into the indoor air of the Site buildings at concentrations that pose an unacceptable risk to building occupants.

A simplified discussion of the DQO steps for the VI investigation is presented below.

Step 1: State the Problem – Soil vapor samples collected from soil gas probes adjacent to three on-Site buildings, and 50 feet from a fourth building, contained VOC concentrations greater than 1×10^{-4} and/or HI=1 industrial risk-based levels. As detailed in the Dispute Resolution Agreement,

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[1] Samples will be submitted for USEPA TO-15 GC/MS analysis operated in either select ion monitoring (SIM) or scanning (SCAN) mode, as needed in order to meet required detection limits.

> *There are a number of operating businesses located on the Site, above or immediately adjacent to fill material and in close proximity to the gas probe locations where elevated levels of VOC and methane were detected.*

In addition, there is at least one residential building located in close proximity to soil vapor probe GP09-09, where elevated concentrations of VOCs were detected.

It is not known whether concentrations of contaminants in soil vapor and shallow groundwater pose an unacceptable risk, via the vapor intrusion pathway, to occupants of structures on, or immediately adjacent to, the Site.

Step 2: Identify the goals of the study – Determine whether contaminant concentrations pose more than a $1{\times}10^{-4}$ cancer risk or a HI greater than 1.0 through the VI pathway to current or potential future receptors. Further, determine whether concentrations of combustible gases within a structure exceed 10 percent of the Lower Explosive Limit (LEL) for methane. Identify buildings where indoor air sampling is required based on the sub-slab sample results.

Step 3: Identify information inputs – Conduct sub-slab soil vapor or, where a structure does not have a concrete slab, indoor air sampling to determine VOC concentrations, through the installation and sampling of sub-slab soil vapor probes and, where appropriate, the collection of indoor air samples.

Step 4: Identify the boundaries of the study – The buildings included in the VI Study are detailed in Section 1.0 above, and presented on Figure 1.

Step 5: Develop the analytic approach – Sub-slab soil vapor samples will be collected from the sub-slab soil vapor probes, following purging in accordance with the FSP. Sub-slab soil vapor and indoor air samples will be submitted for analysis of VOCs in accordance with the requirements of the QAPP and USEPA Method TO-15.

Step 6: Specify Performance or Acceptance Criteria – performance criteria consist of identifying VOC concentrations within existing structures that pose more than a $1{\times}10^{-4}$ cancer risk or a HI greater than 1 to current or potential future receptors via the vapor intrusion pathway, or an exceedance of 10 percent of the LEL. Additional data quality performance and acceptance criteria are outlined in the QAPP.

Step 7: Develop the plan for obtaining data – see Sections 3.1 to 3.2 below, for detailed procedures proposed in order to obtain the required data.

The sub-slab soil vapor investigation is discussed in further detail below.

2.1 Installation of Sub-Slab Soil Vapor Probes

CRA will assess the potential for vapor intrusion by installing and sampling permanent sub-slab soil vapor probes within the on-Site buildings. The proposed sample locations are presented on Figure 1.

Prior to conducting the sampling, CRA will visually inspect the Lots in question and document the number and type of buildings present on each Lot in order to ensure that all buildings that are or may be occupied are included in the sampling program. Lean-tos, car ports, kennels (unless contained within a larger building), open-sided buildings, etc. will not be included in the sampling program. For buildings where explosive gases might accumulate but exposure times, with respect to specific contaminants would typically be small (i.e., small sheds and outbuildings that do not permit long term exposure), CRA will measure the concentration of explosive gas within the building but will not install a sub-slab soil vapor probe or collect an indoor air sample.

Prior to installing the sub-slab probes, a survey will be conducted of each building, to identify potential preferential pathways for vapor migration under the building. The survey will evaluate the presence of underground utilities, floor slab condition, foundation footings, and vadose zone soil conditions known from nearby monitoring well installations. As building-specific conditions dictate, the probes will be installed in the lowest point of the building, at the approximate middle of the building floor slab. The actual locations will be finalized and documented in the field based on the conditions encountered, the presence of underground utilities, potential preferential vapor migration pathways, and detected groundwater concentrations in the vicinity of each building. The final sub-slab probe locations will be selected with a bias to providing the highest anticipated sub-slab soil vapor concentrations determined based on the weight of the available data collected during the building surveys.

USEPA, 2010 recommends the collection of at least one sample per property and that multiple sub-slab probes be installed in a minimum of 10 percent of the buildings included in the investigation. Therefore, CRA will initially install one sub-slab soil vapor probe per building for eighteen (18) of the twenty (20) buildings included in the investigation. For the remaining two buildings, two sub-slab probes will be installed. These two buildings will be selected based on results of the building survey, the potential presence of multiple preferential exposure pathways, and proximity to elevated groundwater concentrations. In each of the two buildings, one probe will be located at the approximate middle of the building, and the second probe will be located where the greatest degree of variability in sub-slab soil vapor concentrations may be expected based on the weight of the available data collected during the building surveys. If the owners of the residence on Lot 3253 grant permission, and should construction considerations allow (i.e., underground utilities, floor materials and floor condition), two sub-slab probes will be installed in the residence on Lot 3253, as residents are considered a more sensitive receptor to exposure via the VI pathway.

CRA will complete the sub-slab soil vapor sampling in accordance with CRA's SOPs for collecting sub-slab soil vapor samples (Attachment A, addendum to the FSP). Based on the analytical results of the initial sampling round, CRA will assess the need to install additional sub-slab soil vapor probes to delineate the lateral extent of impact and to identify the maximum sub-slab soil vapor concentrations in the affected building.

As described in detail in CRA's SOP for sub-slab soil vapor probe installation (Attachment A, addendum to the FSP), CRA will use a concrete corer to drill a "shallow" (approximately 1-inch deep) outer hole (approximately 7/8 inches in diameter) that partially penetrates the floor slab. CRA will then use an electric hammer to drill a smaller diameter inner hole (approximately 3/8 inches diameter) into the center of the outer hole, through the floor material and approximately 3 inches into the sub-slab bedding material to create an open cavity.

CRA will clean cuttings from the outer and inner holes using a towel moistened with distilled water or a small portable vacuum cleaner.

To construct the probes, CRA will cut chromatography grade 316 stainless steel or brass tubing (approximately 1/4–inch in diameter) to a length that allows the probe to float within the slab thickness to avoid obstruction of the probe with sub-slab bedding material. CRA will construct the probes prior to drilling to minimize exposure time, or venting, of the sub-slab bedding material through the open hole.

CRA will place the sub-slab soil vapor probe in the hole so that the top of the probe is flush with the top of the floor. The top of the probe will have a recessed stainless steel or brass plug. CRA will push or inject quick drying Portland cement slurry into the annular space between the probe and the outer hole. The cement will be allowed to dry for at least 24 hours prior to sampling.

2.2 Sub-Slab Soil Vapor Probe Sampling

As detailed in the Interstate Technology & Regulatory Council (ITRC) January 2007 document entitled "Vapor Intrusion Pathway: A Practical Guideline":

> *Precipitation can affect vapor intrusion rates and possible soil gas concentrations. Percolation of water through the soil can displace soil gas and lead to a short-term spike in vapor intrusion. The increased soil moisture after a rain event can reduce vapor*

transport through the soil due to reduced effective porosity and permeability. Measurements made during or immediately after a significant rain event (e.g., >1 inch) may not be representative of long-term average conditions.

As per CRA's SOP in Attachment A, sub-slab vapor sampling will not be performed during or within 48 hours of a significant rainfall event (e.g., greater than 0.5 inches of total precipitation).

CRA will collect and submit the sub-slab soil vapor samples for analysis of benzene, toluene, ethylbenzene, and xylenes, along with chlorinated volatile organic compounds (CVOCs) including perchloroethylene (PCE), trichloroethylene (TCE), cis/trans-1,2-dichloroethylene (1,2-DCE), 1,1-dichloroethylene (1,1-DCE), and VC in accordance with the USEPA Toxic Organics-15 (TO-15) parameter list. CRA's SOP for sub-slab vapor probe sampling is described in detail in Attachment A (addendum to the FSP), and is summarized below.

Prior to sampling, CRA will purge the sub-slab soil vapor probes using a personal sampling pump at a flow rate of less than 200 mL/min. This ensures that the sub-slab soil vapor sample is representative of actual vapor concentrations within the sub-slab bedding material. Prior to purging, CRA will complete a vacuum or tightness test on the sampling assembly to test for leaks (details provided below). CRA will purge two to three purge volumes from the probe assembly prior to collecting the samples from each probe using 6-liter Summa® canisters.

The OSWER, ITRC and Region 5 VI guidance documents do not mandate a required minimum number of sampling events to confirm the results. As such, CRA will collect a minimum of two samples from each location and determine the need for additional sampling events based on the initial two sample results. CRA will resample all of the sub-slab soil vapor probe or indoor air sample locations within no less than three months of the collection of the initial sample to account for seasonal changes. Locations selected for sampling on a second occasion will be sampled at least once during the winter when the surrounding ground is frozen and vapor intrusion is expected to be highest.

Where contaminants are detected in a sub-slab soil vapor or indoor air sample at concentrations that represent an excess lifetime cancer risk above 1×10^{-4} or a non-cancer HI greater than 1, CRA will collect a confirmatory sample as soon as reasonably practicable following receipt of the sample results. Where contaminants are detected in both the original and confirmatory sub-slab soil vapor samples at concentrations that exceed an excess lifetime cancer risk above 1×10^{-4} or a non-cancer HI greater than 1, CRA will collect two indoor air samples (in two discrete sampling events) to determine whether the contaminants detected in the sub-slab samples are migrating to indoor air at concentrations that pose an unacceptable risk to receptors.. The indoor air samples will be collected following the procedures described above and in accordance with the relevant requirements of the FSP and QAPP.

2.2.1 Leak Testing

Prior to purging, CRA will complete a vacuum test on the sampling assembly as the first of two leak-testing steps. During the first leak-testing step, CRA will open the valve to the personal sampling pump leaving the valves to the Summa™ canister and the soil gas probe closed. CRA will then operate the pump to ensure that no ambient air enters the sampling assembly (i.e., the pump should create a negative pressure within the sampling assembly).

During the second leak-testing step, CRA will release a tracer compound to the ground surface immediately around the sub-slab probe surface casing. The tracer test will test for ambient air leakage through the probe assembly. The tracer compound is either monitored for in the field using a meter connected in-line to sampling assembly (e.g., helium), or is included as an analyte in the laboratory analysis of the soil gas samples (e.g., isopropanol). CRA will complete leak testing during sample collection by injecting helium into a shroud covering the sub-slab probe, and monitoring for the presence of helium in the sampling line both before and after sample collection.

Attachment A (addendum to the FSP) details the protocol for leak testing.

2.2.2 QA/QC

For QA/QC purposes, CRA will submit one field duplicate for every 10 samples submitted. Based on the total expected sub-slab soil vapor samples during the initial sampling round, CRA will submit two field duplicate samples. CRA will also submit one trip blank sample for analysis to assess the sample handling procedures, and one background outdoor air sample per day to assess the background concentrations at the time of sampling. Where sampling occurs in more than one area of the Site on a single day, CRA will collect one background outdoor air sample from each area to ensure that local-scale ambient air concentrations of contaminants are characterized. All Summa canisters used in the sampling program will be individually certified by the laboratory to ensure that they are free of contamination prior to collection of the samples. Results of this certification will be included in the VI Investigation Report.

3.0 SCHEDULE

Field work will begin within thirty days of receipt of USEPA approval of the VI Investigation Work Plan, dependant on subcontractor availability, and obtaining access to the various private properties, businesses and residences. Follow-up sampling will be completed within 90 to 120 days of the original sampling event.

4.0 REPORTING

CRA will post the validated analytical results to the South Dayton Dump and Landfill file transfer protocol (ftp) site immediately upon completion of validation. CRA will notify USEPA immediately of any analytical results that demonstrate a potential excess lifetime cancer risk above 1×10^{-4} or a non-cancer HI greater than 1.

The draft VI Investigation Report will be submitted to USEPA within thirty days of receipt of the final laboratory data report from the second sampling event. The draft VI Investigation Report will provide a summary of results from the sub-slab soil vapor and indoor sampling and recommendations for further sampling or remedial actions required to address any unacceptable risks to on- or off-Site receptors. The VI Report will be finalized following receipt of comments from USEPA. Monthly progress reports submitted to USEPA during the investigative work will include the information required for monthly progress reports in the RI/FS SOW.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Stephen M. Quigley

VC/ca/98
Encl.

cc: Tim Prendiville, USEPA
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Tim Hoffman, Dinsmore & Shohl
Paul Jack, Castle Bay
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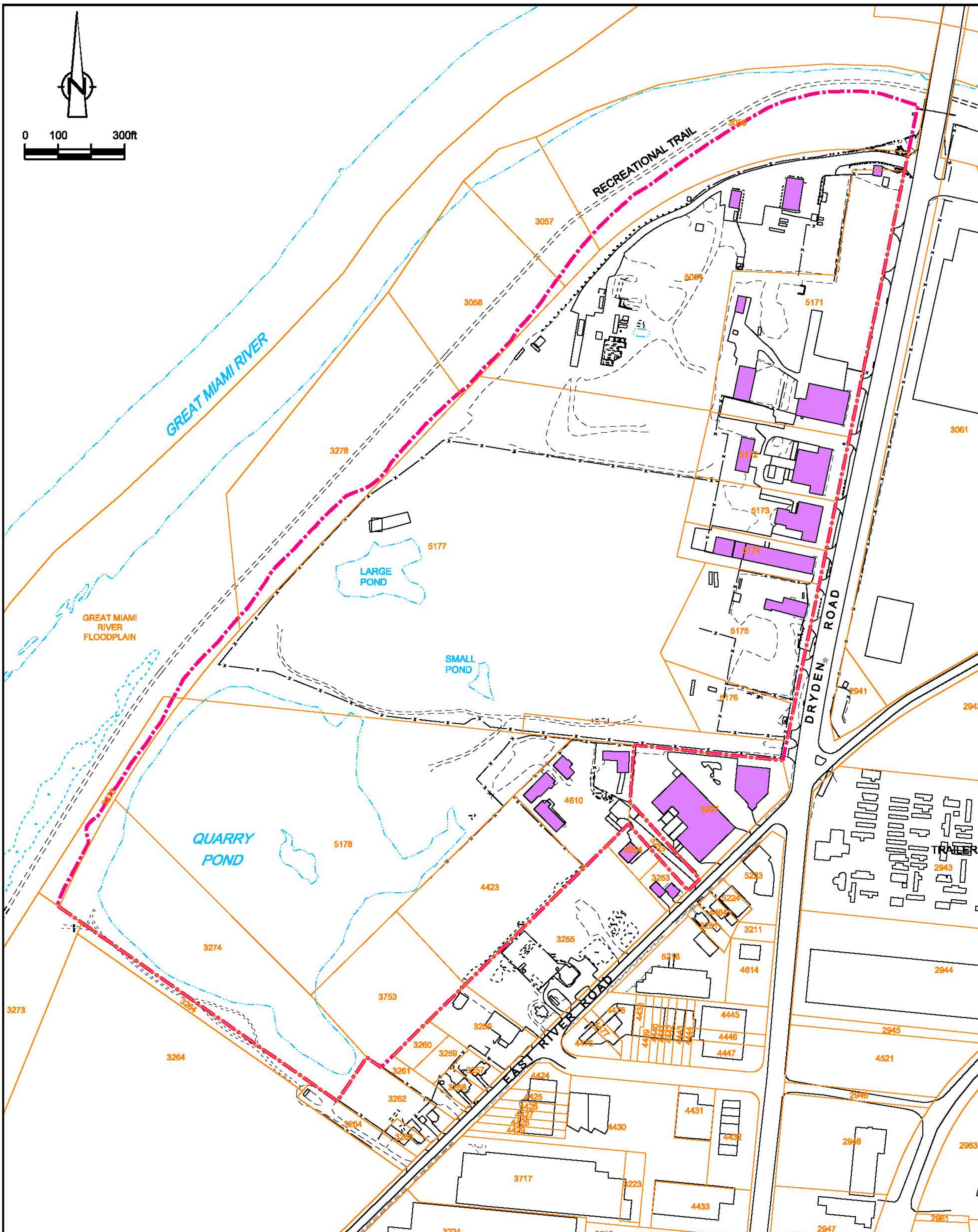
Edward Gallagher, NCR
Karen Mignone, Verrill Dana
Adam Loney, CRA
Jim Campbell, EMI
Chris Athmer, Terran
Bryan Heath, NCR



LEGEND

- APPROXIMATE SITE BOUNDARY
- EDGE OF WATER
- PARCEL BOUNDARY
- SUB SLAB SAMPLING LOCATION

figure 1

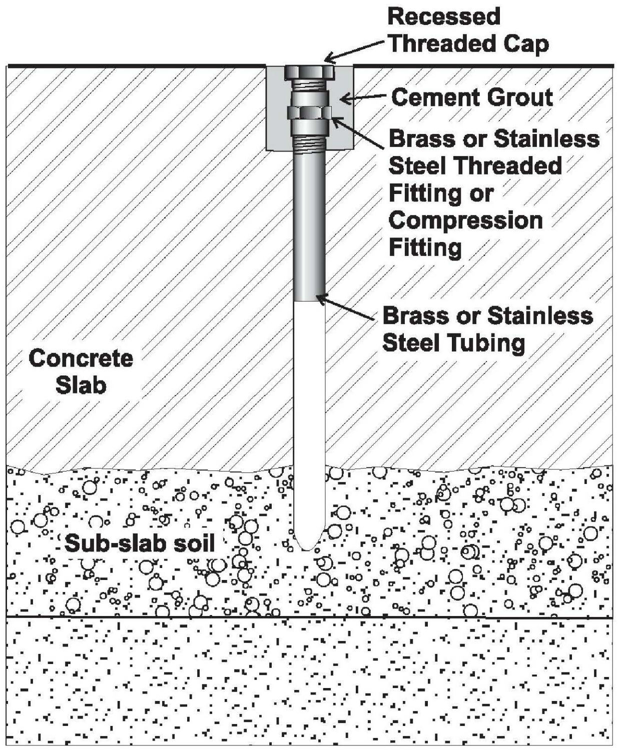
SUB SLAB SAMPLING LOCATIONS
SOUTH DAYTON DUMP AND LANDFILL SITE
Moraine, Ohio

SOURCES:
THE PAYNE FIRM, INC., PROJECT 0279.44.05, FIGURE 1, DATED 9/12/05;
TETRA TECH EM INC., PROJECT L0312006-SOUTH DAYTON DUMP, FIGURE 2, SITE LAYOUT, 05/25/2004;
CITY OF MORAINE.
ABRAMS AERIAL SURVEY INC. PROJECT 38443, AASI 29610, 04/02/2008

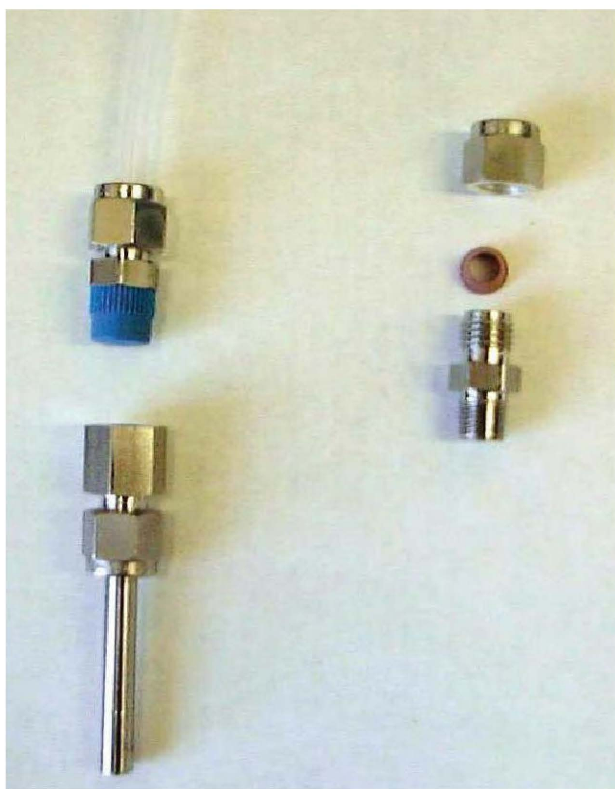
38443-89(CIBU098)GN-WA001 DEC 17/2010

ATTACHMENT A

STANDARD OPERATING PROCEDURE
FOR SUB-SLAB SOIL GAS PROBES



SCHEMATIC OF TYPICAL SUB-SLAB SOIL GAS PROBE



FITTINGS USED FOR SUB-SLAB SOIL GAS PROBE ASSEMBLY

SOURCE: U.S. EPA (2006)

figure A.1

TYPICAL SUB-SLAB SOIL GAS COMPLETION DETAIL
SOUTH DAYTON DUMP AND LANDFILL SITE
Moraine, Ohio

CRA

38443-89(CIBU098)GN-WA002 DEC 17/2010

STANDARD OPERATING PROCEDURE FOR SUB-SLAB SOIL GAS PROBES

1.0 PRIOR PLANNING AND PREPARATION

Prior to installing a sub-slab gas probe:

1. Review the Work Plan and HASP with the Project Coordinator. Understand the existing site geologic/hydrogeologic conditions such as the type of soil, level of water table or perched groundwater table, and properties of refuse (if installing a probe in a landfill) such as depth, leachate levels or perched leachate levels. Know the seasonally high and low water table and leachate elevations, and know if perched conditions exist.
2. Assemble all required equipment, materials, log books, and forms.
3. Coordinate with a drilling/coring contractor (if one is retained) to ensure the work can be completed and to provide them with all relevant information to complete the job prior to arriving on site.
4. Obtain information on the probes to be installed to ensure a complete understanding of the task to be performed. Required information for installation includes knowing the type of gas probe construction materials that are to be used, including knowing the diameter of the probe, depth of probe (length of riser), type and amount of packing material, type of probe material, and planned location for each probe. Also determine if multilevel probes are required.
5. Determine the type of analyses that are required from the probes after installation, and the type of gas monitoring that is required during the drilling and installation of the probe.
6. Arrange access to the site, especially if the property owner is not our client. Obtain all necessary keys. Also consider site conditions (e.g., is snow removal required?).
7. Determine excess soil or refuse disposal procedures before commencing drilling/coring activities.
8. Determine drilling or property access notification requirements with the Project Coordinator. Notify the client, landowner, and appropriate regulatory agencies and complete utility clearance activities in accordance with the FSP.
9. Understand and review the potential health and safety hazards associated with the task and with the site.

These considerations should have been incorporated during development of the Work Plan and should be discussed with the Project Coordinator.

2.0 EQUIPMENT DECONTAMINATION

Prior to use between gas probe locations, drilling and sampling equipment must be decontaminated in accordance with the Work Plan, the Quality Assurance Project Plan (QAPP), or the methods presented in the following section.

The minimal procedures for decontamination of drilling or excavating equipment are:

1. Hot water and detergent wash (brushing as necessary to remove particulate matter).
2. Potable, hot water rinse.

Cover clean equipment with clean plastic sheeting to prevent contact with foreign materials.

On environmental sites, soil sampling equipment (e.g., split-spoons, trowels, spoons, shovels, and bowls) is typically cleaned as follows:

1. Wash with clean potable water and laboratory detergent, using a brush as necessary to remove particulates.
2. Rinse with potable water.
3. Rinse with deionized water.
4. Air dry for as long as possible.

3.0 INSTALLATION PROCEDURES – SUB-SLAB GAS PROBES

Sub-slab soil gas probes allow for collection of sub-slab soil gas samples from directly beneath the slab of a building. Note that sub-slab soil gas probes are not recommended when groundwater is present directly below the slab, as drilling through the slab could allow groundwater to enter the building. A summary of the steps involved in the installation of sub-slab soil gas probes is presented below:

1. Prior to drilling holes into the building floor, the location of utilities coming into the building (e.g., gas, electrical, water, and sewer lines, etc.) will be identified. Avoid installing sub-slab soil gas probes near where utilities penetrate the slab as these may be entry points for downward ambient air migration through the slab during sub-slab soil gas sampling.
2. A rotary hammer drill or equivalent equipment will be used to drill a "shallow" [approximately 1-inch (2.5-cm) deep] outer hole [approximately 7/8 inches (2.2 cm) in diameter] that partially penetrates the floor slab. Cuttings may be removed using a towel moistened with distilled water or small portable vacuum cleaner.
3. The rotary hammer drill or equivalent equipment will be used to drill a smaller diameter inner hole, within the center of the outer hole, approximately 3/8 inch (9.5 mm) in diameter through the floor material and approximately 3 inches (7.6 cm) into the sub-slab bedding material to create an open cavity. The outer hole will be cleaned with a towel moistened with distilled water.
4. Chromatography grade 316 stainless steel or brass tubing will be cut to a length that allows the probe to float within the slab thickness to avoid obstruction of the probe with sub-slab bedding material. The tubing will be approximately ¼ inch (6.4 mm) in diameter. Where necessary, the compression fittings will be stainless steel or brass (approximately ¼ inch O.D. and 1/8-inch NPT) Swagelok® female thread connectors. Whenever possible, the probes will

be constructed prior to drilling to minimize exposure time, or venting, of the sub-slab bedding material through the open hole.

5. The sub-slab soil gas probe will be placed in the holes so that the top of the probe is flush with the top of the floor. The top of the probe will have a recessed stainless steel or brass plug. A quick-drying, Portland cement slurry will be injected or pushed into the annular space between the probe and the outer hole. The cement will be allowed to dry for at least 24 hours prior to sampling.

3.1 INSTALLATION DOCUMENTATION

Details of each sub-slab soil gas probe installation should be recorded on CRA's standard Stratigraphic Log Overburden, or recorded within a standard CRA field book. The Well Instrumentation Log is provided for recording the overburden well instrumentation details, and can be used for sub-slab soil vapor probe installations. This figure must note:

- borehole depth;
- slab thickness;
- probe perforation intervals;
- plug intervals;
- surface cap detail;
- sub-slab soil gas probe material;
- sub-slab soil gas probe instrumentation (i.e., probe length);
- sub-slab soil gas probe diameter;
- cement slurry seal detail;
- stickup/flush-mount detail; and
- date installed.

Each sub-slab soil gas probe installed must have accurate field ties to the center of the sub-slab soil gas probe from three adjacent permanent features of the structure within which the probe is installed, each located in a different direction from the installation.

Each sub-slab soil gas probe must be permanently marked to identify the sub-slab soil gas probe number designation.

4.0 RESPIRATORY PROTECTION

The HASP must be followed with regard to respiratory protection.

5.0 FOLLOW-UP ACTIVITIES

Once the sub-slab soil gas probe(s) have been completed, the following activities need to be done:

1. Conduct initial monitoring round of gas probes.
2. All logs will be submitted to CRA's hydrogeology department who will be responsible for the generation of the final well log.
3. Arrange surveyor to obtain accurate horizontal and vertical control.
4. Gas probe/boring locations will be accurately plotted on the site plan, since boring locations may change in the field due to utility interferences or other conditions.
5. Tabulate sub-slab gas probe details.
6. A summary write-up on field activities including, but not necessarily limited to such items as drilling method(s), construction material, etc.
7. Field book will be kept at the appropriate CRA office.

6.0 FIELD INSTRUMENTATION CALIBRATION

Sampling or monitoring equipment used in the sub-slab soil gas and outdoor air sampling program to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specification and requirements. Field calibration of the personal sampling pump and PID meter will be carried out prior to sampling activities.

The vacuum gauge used to measure canister vacuum will be calibrated and provided by the laboratory. The vacuum gauge will be returned to the laboratory for the laboratory to obtained vacuum measurements prior to sample analysis (checking canister integrity was maintained during shipment). Using a common vacuum gauge will avoid variations in vacuum measurements that can arise due to using different vacuum gauges.

7.0 SUB-SLAB SOIL GAS SAMPLING PROTOCOL

The following sections describe the protocol for sub-slab soil gas sampling from permanent sub-slab soil gas probes. For evaluating vapor intrusion, permanent sub-slab soil gas probes are preferable to allow for multiple sub-slab soil gas sampling events. More than one sub-slab soil gas sampling event is often required when assessing vapor intrusion to address seasonal variations and temporal variability commonly observed in sub-slab soil gas concentrations.

Sub-slab soil gas sampling should commence a minimum of 24 hours following installation of the sub-slab soil gas probes, to allow time for disturbances created by drilling to dissipate and allow the formation to return to an equilibrium condition. In fine-grained soil conditions, consideration should be given to allowing a greater amount of time for equilibrium conditions to become re-established (e.g., 72 hours). Sub-slab soil gas sampling will not be performed during or within 48 hours of a significant rainfall event [e.g., >0.5 inches after Cal EPA (2003)]. This will avoid the potential that increased moisture content in the unsaturated zone soil could temporarily dampen sub-slab soil gas concentrations, or possibly prevent sub-slab soil gas sample collection (i.e., such as in cases where the sub-slab soil gas probe screened interval could become temporarily saturated due to the passing infiltration front). In fine-grained soil conditions, consideration should be given to allowing a greater amount of time for rainfall events to dissipate. The potential influence of rainfall events on sub-slab soil gas concentrations is less of concern in cases where the sub-slab soil gas probes are located beneath impervious ground cover (e.g., pavement or building foundation).

A summary of the steps involved in sub-slab soil gas sampling is presented below:

i) Sub-slab soil gas samples for assessing the vapor intrusion pathway will be collected using certified clean Summa™ canisters. Only canisters certified clean at the 100 percent level can be used for sub-slab soil gas sampling activities (i.e., pre-cleaned at the laboratory in accordance with U.S. EPA's TO-15 method and documentation of the cleaning activities will be provided by the laboratory). Summa™ canisters typically come in 1-, 1.7-, and 6-liter capacities, depending upon laboratory availability. Consideration should be given to using smaller capacity canisters to reduce sample volume and increase confidence that the sub-slab soil gas sample is drawn from the formation immediately surrounding the probe screen during sampling. Larger volume samples can promote drawing ambient air down the annulus of the sub-slab soil gas probe which can dilute the sub-slab soil gas sample. The use of the smaller canister sizes becomes more critical in fine-grained soil conditions where the formation may not give up significant sub-slab soil gas volumes (in this case, ambient air infiltration down the sub-slab soil gas probe annulus can be more problematic).

ii) The Summa™ canisters will be fitted with a laboratory calibrated critical orifice flow regulation device sized to restrict the maximum sub-slab soil gas sample collection flow rate to approximately 100 milliliters per minute (mL/min), which corresponds to the lower end of the maximum sub-slab soil gas sampling flow rate recommended by Cal EPA (2003) of 100 to 200 mL/min. The 100 mL/min maximum flow rate translates to sample collection times of 10, 17, or 60 minutes, respectively, for of 1-, 1.7-, or 6-liter canister capacities. A maximum flow rate of 100 mL/min is recommended to limit VOC stripping from soil, prevent the short-circuiting of ambient air from ground surface down the sub-slab soil gas probe annulus that would dilute the sub-slab soil gas sample. A maximum flow rate of 100 mL/min increases confidence that the sub-slab soil gas sample is drawn from immediately surrounding the screened interval.

iii) A vacuum gauge will be supplied by the laboratory and used during sample collection to measure the initial canister vacuum, canister vacuum during sample collection, and residual canister vacuum at the end of sample collection. The vacuum gauge will be returned to the laboratory and used by the laboratory to measure the residual canister vacuum upon receipt of the canisters by the laboratory. Using the same vacuum gauge throughout the entire sampling process will eliminate discrepancies between vacuum measurements that can arise from using different gauges with a potentially different sensitivity and/or calibration.

iv) The canister will be connected to the sub-slab soil gas probe valve at the surface casing using the sampling assembly that is depicted on Figure 15.5. The sampling assembly is connected using short lengths [e.g., 1-foot (0.3 m)] 1/4-inch (6.4 mm) or 3/8-inch (9.5 mm) diameter tubing (the tubing material will be Teflon® or nylon) and air-tight stainless steel or brass tee-connectors and tee-valves (e.g., Swagelok® type). The canister will be connected to the sub-slab soil gas probe along with a vacuum gauge and a personal sampling pump, all in series, using tee-connectors or tee-valves (in the order of sub-slab soil gas probe, vacuum gauge, pump, and canister). A tee-valve will be used to connect the pump, which will allow the pump to be isolated from the sampling assembly during sample collection. Fresh tubing will be used for each sample.

v) Prior to collecting a sub-slab soil gas sample, the stagnant air in the sampling assembly tubes and sub-slab soil gas probe casing/sand pack must be removed. The sub-slab soil gas probes will be purged prior to sampling using the personal sampling pump at a flow rate of less than 200 mL/min. This ensures that the collected sub-slab soil gas sample is representative of actual sub-slab soil gas concentrations within the formation. Measurements of the lengths and inner diameters of the above-ground sampling assembly and below-ground gas probe casing, screen, and sand pack should be used to calculate the "purge volume" (the purge volume will consider the pore volume of the sand pack assuming a 30 percent sand pack porosity). Prior to sample collection, two to three purge volumes should be drawn from the probe/sample assembly, unless otherwise required by the applicable regulatory guidance. The purge data (calculated purge volume, purging rate, and duration of purging) should be recorded in the field logbook.

vi) Prior to purging, a vacuum, or tightness, test will be conducted on the sampling assembly as the first of two leak-testing steps, as described further in Section 15.2.4. Briefly, this first leak-testing step (the vacuum test) will consist of opening the valve to the personal sampling pump leaving the valves to the Summa™ canister and the sub-slab soil gas probe closed. The pump will then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are air-tight. Further details of the vacuum test are described below.

vii) Prior to purging, and following the vacuum test, the set-up for the second of the two leak-testing steps will be conducted. The second leak-testing step is the tracer compound step. A tracer compound is released at ground surface immediately around the sub-slab soil gas probe surface casing. The tracer test is used to test for ambient air leakage down the annulus of the sub-slab soil gas probe and into the sub-slab soil gas sample. The tracer compound is either monitored for in the field using a meter connected in-line to sampling assembly (e.g., helium), or is included as an analyte in the laboratory analysis of the sub-slab soil gas samples (e.g., isopropanol). The set-up requirements of the tracer compound leak-testing step are described below.

viii) Following the vacuum test, and the set-up for the tracer compound leak-testing step, the sub-slab soil gas probe purging will commence by opening the valve to the sub-slab soil gas probe and activating the personal sampling pump (and leaving closed the valve to the Summa™ canister). At the start and the end of the purging period, the total concentration of volatile organic vapors of the personnel sampling pump exhaust gas will be monitored using a portable photoionization detector (PID) meter. The PID meter will be connected in series after the personal sampling pump. Since typical PID instrument flow rates vary from approximately 300 mL/min to 500 mL/min (depending on the manufacturer and model), drawing a sample into the PID meter through the personal sampling pump likely will increase the purging flow rate temporarily until a reading from the PID meter is obtained. PID readings will be recorded and entered in the field logbook and chain of custody form. The PID readings will provide the laboratory with an indication of whether a sample could require dilution before analysis.

ix) Following purging, the valve to the personal sampling pump will be closed, and the valves to the sub-slab soil gas probe and Summa™ canister will be opened to draw the sub-slab soil gas sample into the canister concurrent with continuing to apply the leak-testing tracer compound. The vacuum gauge reading will be recorded during sample collection. Should the vacuum gauge reading remain elevated above 10-inches mercury (Hg) for more than 30 minutes, this will be taken to indicate that the initial vacuum in the canister has not sufficiently dissipated, and that the soil screened by the sub-slab soil gas probe does not produce sufficient sub-slab soil gas to permit sample collection.

x) To ensure some residual vacuum in each canister following sample collection, the canister vacuum will be recorded at approximately 80 percent through the expected sample collection duration. With a 100 mL/min maximum flow rate, the expected sample collection duration would be 10, 17, or 60 minutes, respectively, for canister capacities of 1, 1.7, or 6 liters. A maximum residual vacuum of 10-inches Hg is allowed. A canister residual vacuum above this value will require continued sampling until vacuum reading is below this threshold, unless the vacuum remains above 10-inches Hg for more than 30 minutes, as described above. A minimum 1-inch Hg residual vacuum will be required for the sample to be considered valid, or the sampling will be repeated using a fresh Summa™ canister. Once the vacuum is measured, the safety cap will be securely tightened on the inlet of the Summa™ canister prior to shipment to the laboratory under chain of custody procedures.

xi) The vacuum gauge provided by laboratory will be returned with the canister samples to check residual vacuum in the laboratory prior to sample analysis and recorded on the analytical data report. This check will ensure sample integrity prior to laboratory analysis, and that the canister has not become compromised during shipment to the laboratory.

xii) If the critical orifice flow regulation devices (provided by the laboratory) and sampling assembly fittings/valves are to be re-used during sampling, they will be cleaned in accordance with laboratory requirements by purging with zero air (provided by laboratory) for minimum 45 seconds at minimum 75 psi.

xiii) The canisters will be labeled noting the unique sample designation number, date, time, and sampler's initials. A bound field logbook will be maintained to record all sub-slab soil gas sampling data.

xiv) The canisters will be listed on the chain-of-custody in order of suspected highest to lowest impact, as evidenced by the recorded PID readings. Indicate on the chain-of-custody for the laboratory to analyze the canisters in order from the lowest to highest PID reading.

The sub-slab soil gas samples will be analyzed for VOCs by the project laboratory using U.S. EPA's TO-15 gas chromatograph/mass spectrometer (GC/MS) methodology, with the mass spectrometer (MS) run in full scan mode. Quality control/quality assurance (QA/QC) measures implemented during the sub-slab soil gas sampling event will include the two-step leak testing procedure (see Section 15.2.4), maintaining a minimum residual vacuum in the Summa™ canisters following sample collection, collection of one duplicate per sampling event or from at least 10 percent of the samples obtained, and collection of an ambient air sample.

8.0 SUB-SLAB SOIL GAS PROBE LEAK TESTING

The use of leak testing is recommended as a quality control check to ensure ambient air has not leaked into the sub-slab soil gas probe or sampling assembly, which may affect (i.e., dilute) the analytical results. Contaminants in ambient air can also enter the sampling system and be detected in a sample from a non-contaminated sampling probe resulting in a "false positive" result. The leak testing will be conducted in the following two steps:

- Step 1 - Vacuum Test: used to ensure that the tubing and fittings/valves that make up the sampling assembly are air tight; and
- Step 2 - Tracer Test: used to ensure that ambient air during sub-slab soil gas sample collection is not drawn down the sub-slab soil gas probe annulus through an incomplete seal between the formation and the sub-slab soil gas probe casing.

The vacuum test and tracer test are detailed below.

Step 1 - Vacuum Test

- The sampling assembly will be connected to the sub-slab soil gas probe valve at the surface casing. Once connected, the sampling assembly will consist of the sub-slab soil gas probe, the vacuum gauge supplied by the laboratory, personal sampling pump, and Summa™ canister, all connected in series (i.e., in the order of sub-slab soil gas probe, vacuum gauge, pump, and canister), using tee-connectors or tee-valves.
- The personal sampling pump will be used to conduct the vacuum test. The vacuum test will consist of opening the valve to the personal sampling pump while leaving closed the valves to the Summa™ canister and the sub-slab soil gas probe. The pump will then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are air-tight. The sampling pump low-flow detect switch will likely activate within 10 to 15 seconds, turning the pump off. A negative pressure, or vacuum, should be established within the sampling assembly, and should be sustained for at least 1 minute.
- If the pump is capable of drawing flow, or if the vacuum is not sustained for at least 1 minute, all fittings and tubing will be checked for tightness (or replaced) and the vacuum test will be repeated.
- The reading from the vacuum gauge pressure will be recorded in field logbook to demonstrate that the pump is able to create a vacuum within the sampling assembly (it will also be noted whether the low-flow detect switch on the pump was activated), and that the vacuum is sustained for at least 1 minute.

Step 2 - Tracer Test

A tracer compound is released at ground surface immediately around the sub-slab soil gas probe surface casing and is used to test for ambient air leakage down the annulus of the sub-slab soil gas probe and into the sub-slab soil gas sample. Two options are described below for the tracer test where either isopropanol (Option A) or helium (Option B) is used as the tracer compound.

Option A - Isopropanol

- For Option A, isopropanol is used as the tracer compound. It is included as an analyte in U.S. EPA's TO-15 method, it is readily available (i.e., as isopropyl rubbing alcohol), and it is safe to use.
- Approximately 1 teaspoon (approximately 4 mL) of isopropanol (rubbing alcohol) will be mixed in 1 gallon of de-ionized water to create an approximate 1/1,000 solution.
- Paper towels soaked in the dilute solution of isopropanol will be wrapped around the sub-slab soil gas probe surface casing and ground surface immediately surrounding the surface casing. Sub-slab soil gas probe surface casing then will be covered over using clear plastic sheeting that will be sealed to the ground surface. As the ground surface finish permits, sealing the plastic sheeting to ground surface will be accomplished using tape or by weighting the edges of the plastic sheeting with dry bentonite.
- Immediately before conducting the sub-slab soil gas probe purging, remove the paper towels from the solution wringing out the towels so they are very damp, but not dripping, before placed them around the vapor probe and sealing them in place using the plastic sheeting.
- The isopropanol solution will be kept fresh, with new solution being made every hour. The solution will be mixed at a central location away from the sampling activities. The isopropanol will be kept tightly capped and kept away from all sampling equipment. The solution will be kept away from the sampling assembly until immediately before sample collection begins. Sampling personnel will wear latex gloves while handling the solution and soaked paper towels, and will remove the gloves while working with the sampling assembly.
- Soil samples with laboratory analytical results for isopropanol that are greater than 10 percent of the starting concentration of isopropanol in the vapors emitted from dilute isopropanol solution will not be considered reliable and representative of sub-slab soil gas concentrations within the formation (ITRC, 2007). The starting concentration will be calculated based on the concentration of isopropanol in the dilute solution, the vapor pressure of isopropanol, and Henry's law.
- A disadvantage in using isopropanol as the tracer compound is that it will not be known whether a significant leak occurred until after the cost of analyzing the sample has been spent. Elevated levels of isopropanol can also interfere with laboratory analytical method detection limits.

Option B - Helium

- The presence of helium within the sampling assembly will be monitored during purging and sub-slab soil gas sample collection using a helium meter installed in-line with the sampling assembly just before the personal sampling pump.
- Helium is readily available at a variety of retail businesses, is safe to use, and does not interfere with laboratory analytical method detection limits.

- A containment unit is constructed to cover the sub-slab soil gas probe surface casing. The containment unit will consist of an over-turned plastic pail set into a ring of dry bentonite to create a seal between the ground surface and the rim of the pail. The pail can be set directly on top of the sampling assembly tubing connected to the sub-slab soil gas probe, which when pressed into the dry bentonite, should create a sufficient seal around the tubing. The pail will have two holes: one to allow for the introduction of helium; and the other to allow for air trapped inside the pail to escape while introducing the helium. The second hole will also allow insertion of the helium meter to measure the helium content within the pail.
- Prior to sub-slab soil gas probe purging, helium will be introduced into the containment unit to obtain a minimum 50 percent helium content level. The helium content within the containment unit will be confirmed using the helium meter and recorded in the field logbook. Helium will continue to be introduced to the containment unit during sub-slab soil gas probe purging and sampling, but care will be taken not to increased the pressure within the containment unit beyond that of atmospheric pressure.
- During sub-slab soil gas probe purging and sampling, the helium meter will be connected in-line with the sampling assembly. In the event that the helium meter measures a helium content with the sampling assembly of greater than 10 percent of the source concentration (i.e., 10 percent of the helium content measured within the containment unit), the sub-slab soil gas probe will be judged to permit significant leakage such that the collected sub-slab soil gas sample will not be considered reliable and representative of sub-slab soil gas concentrations within the formation (ITRC, 2007).
- An advantage of using helium as the tracer compound is that a significant leak can be detected in the field and the cost of analyzing the Summa™ canister can be avoided.

REFERENCES

Cal EPA, 2003. Advisory – Active Sub-slab soil gas Investigations, Department of Toxic Substances Control, January 28.

Cal EPA, 2005. Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion in Indoor Air. Department of Toxic Substances Control, (revised February 7).

ITRC, 2007. Vapor Intrusion Pathway: A Practical Guide, January.

U.S. EPA, 1988. The Determination of Volatile Organic Compounds in Ambient Air Using Summa™ Passivated Canister Sampling and Gas Chromatographic Analysis, May.

USEPA, 1999. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air Second Edition, EPA/625/R-96/010b, January 1999.

U.S. EPA, 2006. Assessment of Vapor Intrusion in Homes Near the Raymark Superfund Site Using Basement and Sub-Slab Air Samples, March 2006. EPA/600/R-05/147.

ATTACHMENT B

SOP FOR THE INDOOR AIR SAMPLING

TABLE OF CONTENTS

LIST OF FORMS
(Following Text)

1.0 INTRODUCTION

This Attachment presents the indoor air sampling protocol employed by Conestoga-Rovers & Associates to evaluate the potential presence of volatile organic compounds (VOCs) in indoor air due to subsurface soil and/or groundwater impacts. The protocol presented herein consists of conducting a physical survey of the building to be sampled in conjunction with interviewing building occupants, followed by collection of indoor air samples using 6-liter Summa™ canisters. This indoor air sampling protocol has been developed in consideration of the sampling procedures recommended in the following regulatory guidance documents:

- "*Indoor Air Sampling and Evaluation Guide*" dated April 2002 and prepared by the Massachusetts Department of Environmental Protection (MDEP) (MDEP, 2002)
- "*Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion – Interim Final*" dated December 15, 2004 (and revised February 7, 2005) and prepared by the California Environmental Protection Agency (Cal EPA) (Cal EPA, 2004)
- *"Draft Vapor Intrusion Pilot Program Guidance"* dated April 26, 2006 and prepared by the Indiana Department of Environmental Management (IDEM) (IDEM, 2006)
- United States Environmental Protection Agency (USEPA) – Region 5 - *Vapor Intrusion Guidebook,* October 2010 (USEPA, 2010)

Section 2.0 presents the physical building survey to be conducted that will enable a qualitative assessment of factors that potentially could influence indoor air quality. Section 3.0 presents the indoor air sample collection procedure, including quality assurance/quality control (QA/QC) measures and laboratory analytical methodology to be applied in the sample analysis.

2.0 PHYSICAL BUILDING SURVEY

A physical survey will be conducted of the buildings to be sampled. The physical survey will be conducted in conjunction with interviewing the occupants of the buildings. The purpose of the physical survey is to obtain data that will allow a qualitative assessment of factors that potentially could influence indoor air quality. The physical survey includes collecting data on aspects of the building configuration such as building layout, attached garages, utility entrances into the building, ventilation system design, foundation conditions, presence of foundation sump, building material types (e.g., recent carpeting/linoleum and/or painting), location of laundry facilities, etc. The physical survey also includes collecting data related to occupant lifestyle choices that could potentially influence indoor air quality such as use of cleaning products, dry-cleaner use, indoor storage of paints and/or petroleum hydrocarbon products, use of aerosol consumer products, smoking, etc.

The physical survey will be documented by completing the attached Form 1 – Building Physical Survey Questionnaire.

3.0 INDOOR AIR SAMPLE COLLECTION PROCEDURE

Indoor air samples will be collected from the buildings which are or may be occupied that have no slab (e.g., dirt or gravel floor). The indoor air sample will be collected from the lowest floor of the building. An outdoor ambient air sample will be collected concurrently with the indoor air sample from an upwind location on the building property. The indoor and ambient air samples will be collected using a Summa™ canister (6-litre capacity) equipped with a critical orifice flow regulation device sized to allow the collection of an air sample over an 8-hour sampling period. The critical orifice flow regulation device will be supplied and calibrated by the laboratory selected to conduct the sample analysis.

To the extent possible, the indoor air samples will be collected with windows and doors closed to represent appropriately conservative conditions during sampling. If possible, windows and doors should be kept closed for a period of at least 24 hours prior to sample collection. During summer months, air conditioners typically would be operating under closed windows/doors conditions, and the operation of an air conditioner can be allowed during sample collection. This would be representative of season-specific ventilation conditions, and with the expected pattern of operation of the building. Care will be taken to deploy the Summa™ canisters away from the direct influence of any forced air emanating from an air conditioning unit or central air conditioning vents.

The indoor air sampling procedure is described as follows:

- Samples will be collected from an occupied building and as close as practical to the center of the area, but away from high traffic areas to minimize the potential for disturbances during sample collection. Typically, sample canisters will be located between 1 to 1.5 meters above floor level.
- For each ambient air sample, a suitable upwind location (selected to minimize the potential for disturbances during sample collection) will be selected. The ambient air sample will be collected a minimum of 1 meter above grade (if possible) and located to minimize the potential for disturbance of the canister while providing protection from weather effects.
- Air sample canisters will be labeled with a unique sample designation number. Both the sample number and the sample location information will be recorded on the attached Form 2 – Indoor Air Sampling Field Data Sheet.
- The Summa™ canister vacuum will be measured immediately prior to canister deployment and recorded on Form 2 – Indoor Air Sampling Field Data Sheet.

- The critical orifice flow controller will be installed, as supplied by the laboratory, on the canister and the canister will be opened fully at the beginning of sample collection period and start time recorded on Form 2 – Indoor Air Sampling Field Data Sheet.
- At the start and the end of the 8-hour sample period, a portable photoionization detector (PID) will be used to screen for VOC presence in the sample area. Results of the PID monitoring were recorded on Form 2 – Indoor Air Sampling Field Data Sheet.
- Other data recorded on Form 2 – Indoor Air Sampling Field Data Sheet will include: outside and interior temperatures both at the start and end of the sample period, equipment serial numbers, sampler name, and any comments.
- Following equipment setup, the building occupant will be given the list of instructions to follow while the Summa™ canister sample is being taken in the building. The instructions are listed in the attached Form 3 - Indoor Air Sampling Instructions to Building Occupants. The date and completion time of the 8-hour sample period will be written on Form 3 and the occupant will be instructed that the sampling team would be back to pick up the canister after approximately 8 hours.
- The canister valve will be closed fully at the end of the sample period (after 8 hours) and the end time recorded on the field data sheet. If there is evidence of canister disturbance during the sample collection, this will be recorded on Form 2 – Indoor Air Sampling Field Data Sheet.
- The Summa™ canister vacuum will be measured immediately after canister retrieval at the end of the 8-hour sample period and recorded on the field data sheet. Any samples where the canister reached atmospheric pressure will be rejected and the canisters returned for cleaning. The minimum vacuum required to be considered a valid sample will be 1 to 2 inch Hg vacuum. Once the vacuum is measured, the safety cap will be securely tightened on the inlet of the Summa™ canister prior to shipment to the laboratory under CRA chain of custody procedures. The requirement for residual vacuum retained in the canister following sample collection is to ensure that a driving force was maintained to collect a steady flow rate until the end of the sampling event.
- The Summa™ canister vacuum will be measured by the laboratory immediately prior to sample analysis and recorded on the analytical data report.
- All canisters will be cleaned in accordance with United States Environmental Protection Agency (USEPA) Method TO-15 and documentation of the cleaning activities will be obtained from the laboratory.

3.1 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) samples will collected during the indoor air sampling. QA/QC samples will include:

- the ambient air sample
- one duplicate

3.2 ANALYTICAL METHOD/LABORATORY

The soil vapor samples will be analyzed by a certified laboratory using the USEPA TO-15 gas chromatograph/mass spectrometer (GC/MS) methodology.

3.3 DATA VALIDATION

A data validation for the air sample result will be conducted by CRA.

3.4 CANISTER CLEANING

Canister cleaning was completed in accordance with the applicable sections of Method TO-15.

4.0 REFERENCES

Cal EPA, 2004. Guidance on the Evaluation and Migration of Subsurface Vapor Intrusion to Indoor Air – Interim Final, Department of Toxic Substances Control, California Environmental Protection Agency, December 15 (revised February 7, 2005).

IDEM, 2006. Draft Vapor Intrusion Pilot Program Guidance. Indiana Department of Environmental Management, April 26.

MDEP, 2003. Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430, Office of Research and Standards, Massachusetts Department of Environmental Protection, April.

USEPA, 2010. Region 5 - Vapor Intrusion Guidebook, United States Environmental Protection Agency .

FORM 1: BUILDING PHYSICAL SURVEY QUESTIONNAIRE

Address: ______________________________

Building Owner: ______________________________

Occupant Name: ______________________________

Date: _______ Time: ______ Inspector: _______________ Sample No.: _________________

Contact Name: ______________________ Phone Number: ______________________

How long have you lived/worked in this home/building? _______

Occupation: ____________________________________

Number of Occupants Adults: _____________
Children: ___________

BUILDING TYPE: One story ____ Two storey ______ Brick _____ Siding _____ Stucco ___

DESCRIBE BUILDING: _________________ **YEAR CONSTRUCTED**: ________________

WEATHER SEALS: General Condition: Good ______ Fair ______ Poor ______

BASEMENT:		Finished	Unfinished	Depth below reference point (meters)
None	❑			
Partial	❑	❑	❑	_________________
Full	❑	❑	❑	_________________
Crawl space	❑	na	na	_________________

Number of floors at or above grade: _______

Depth of basement below grade: _______ ft. Basement Size: _______ ft^2

Foundation construction: Poured concrete ❑ Cinder block ❑ Stone ❑

Any visual evidence of leakage through basement walls or floor ❑

Floor Construction: Poured concrete ❑ Wood ❑ Earth ❑ Brick ❑ Other: _______

Floor condition (cracks, drains): ____

Condition at floor/wall joint (if visible): ____

Any exterior openings from the basement:

- ❑ Vents
- ❑ Fans
- ❑ Windows

- ❑ Wall openings
- ❑ Utility pipe penetrations
- ❑ Other: ______________________

Type of ground cover outside of building: grass / concrete / asphalt / other (specify): _______

Sub-slab vapor/moisture barrier in place? Yes / No / Don't know

Type of barrier: ____________

Do you have a sump?: Yes ❑ No ❑

Where: ________________________

If yes, sealed ❑ open ❑ NA ❑

If yes, is there water in the sump?: Yes ❑ No ❑

Is this building serviced with municipal water? Yes ❑ No ❑

Do you have a water well?: Yes ❑ No ❑ Don't know ❑

Well location: ______________________________

Do you drink the water obtained from the well? ______________________________________

What do you use the well for?: ____

Do you have a cistern?: Yes ❑ No ❑

If yes, describe its location: ____

Do you have a septic system?: Yes ❑ No ❑

If yes, describe its location: ____

If yes, describe how septic system is cleaned: ____

____

Have there ever been a fire in the building?: Yes ❑No ❑

If yes, describe its location and extent: ____

Is there a laundry room located inside the house/building?: Yes ❑ No ❑

If yes, describe its location: ____

FURNACE: Location:____

Type:				
	gas	❑	Forced air	❑
	oil	❑	hot water	❑
	electric	❑	other	____________________________

Does furnace have outside combustion air vent? _________________

Do you have a fireplace? Yes ❑ No ❑

Does the fireplace have an outside combustion air vent? Yes ❑ No ❑

Do you use kerosene space heaters? Yes ❑ No ❑

FORM 1: BUILDING PHYSICAL SURVEY QUESTIONNAIRE

AIR CONDITIONER: None _______ Central __________ Room _____________
(If yes, which rooms and capacities?) _____________________________________

RADON SYSTEM: ❑ Yes ❑ No

GARAGE: Do you have an attached garage? ❑ Yes ❑ No

---

1. When was the last time dry-cleaned clothes were brought into the house/building?

   ❑ 0 to 5 days ago ❑ 6 to 10 days ago ❑ More than 10 days ago ❑ Don't dry-clean

2. When was your carpet installed?

   ❑ In the last six months ❑ More than six months ago ❑ No Carpet

3. When was the last time your carpet was cleaned?

   ❑ In the last six months ❑ More than six months ago ❑ Never

4. Do you have any spot removers in the house?

   ❑ Yes ❑ No Details: ________________________

5. Do your hobbies include model building, arts and crafts, model railroading, or others that require paints, thinners, or glue?

   ❑ Yes ❑ No Details: ________________________

6. Do you perform automotive or other vehicle maintenance or repair at home?

   ❑ Yes ❑ No Details: ________________________

7. Please review the following list and check items you know are in your home

   ❑ Latex caulk
   ❑ Latex paint
   ❑ Vinyl cove molding
   ❑ Linoleum tile
   ❑ Black rubber molding
   ❑ Vinyl edge molding
   ❑ Polystyrene foam insulation
   ❑ Adhesive removers

- ❑ Aerosol spray paints
- ❑ Other paints
- ❑ Air fresheners
- ❑ Degreasers
- ❑ Deodorants
- ❑ Disinfectants
- ❑ Furniture Polish
- ❑ Solvents
- ❑ Caulking

8. Do you have pesticides in your home/building?

❑ Yes ❑ No ❑ Unsure

9. Do you have any spray insecticides in your home/building?

❑ Yes ❑ No ❑ Unsure

10a. Have you painted any area of the interior of your home/building in the last 12 months?

❑ Yes ❑ No

10b. If yes, please indicate what paint you used

- ❑ Enamel
- ❑ Vinyl
- ❑ Latex
- ❑ Other

11a. Have you painted the exterior of your building in the last 12 months? ❑ Yes ❑ No

11b. If yes, please indicate what paint you used

- ❑ Enamel
- ❑ Vinyl
- ❑ Latex
- ❑ Other

12. Where do you store your paint, thinner, pesticides, insecticides?

	Paint	*Thinner*	*Pesticides*	*Insecticides*
Garage	❑	❑	❑	❑
Basement	❑	❑	❑	❑
Storage shed	❑	❑	❑	❑
Other	❑	❑	❑	❑

❑ I don't store these items at home

13. Have you purchased one of the following items in the last 12 months?

❑ Rubberized door mat ❑ Computer ❑ Wiring
❑ Plastic shower curtain ❑ Printer ❑ Linoleum
❑ Wood stains or paint ❑ VCR

14. Do you have a computer printer in your home/building?

❑ Yes ❑ No

15. Do you have a VCR in your home/building?

❑ Yes ❑ No

16. Do you use cleaners to maintain your VCR/building?

❑ Yes ❑ No

If yes, what type? ______________________________

17. Do you have pets residing in this building?

❑ Yes ❑ No

If yes, what type? ______________________________

If yes, number ______________________________

18. Does anyone in the building smoke? ❑ Yes ❑ No

19. Questions asked by Occupant that require follow-up.

____

____

____

____

FORM 2: INDOOR AIR SAMPLING FIELD DATA SHEET

A) General Information

Sample Identification Number: ____________________

Site Address: ____________________

Sample Canister Location: ____________________

Sample source: Indoor Air / Sub-Slab / Near Slab Soil Gas / Exterior Soil Gas

Sample Date: ____________ Sampler: ____________

Sample Time: Start: ____________ Stop: ____________

Shipping Date: ____________________

Canister Type: 400 mL – 1.0 L Summa Canister/6 L Summa Canister/Other (specify):

____

Canister Serial No.: ____________________

Flow Controller Serial No.: ____________________

Were “Instructions for Occupants” followed?

❑ Yes ❑ No

B) Sampling Information

	Start		Stop	
	Ambient	Interior	Ambient	Interior
Temperature	______	______	______	______

	Start	Stop
Canister Pressure Gauge Reading:	______	______
Time:	______	______
PID Reading (ppm):	______	______
Basement Depth (ft below grade):	______	
Window Marked:	Yes/No	

Was there significant precipitation within 12 hours prior to (or during) the sampling event?

❑ Yes ❑ No

Describe the general weather conditions: ____________________

____

____

Provide Drawing of Sample Location(s) in Building

C) Comments

1. The duration of this test is approximately 8 hours.

2. The canister is made of clean stainless steel. It does not contain any moving parts or chemicals.

3. Do not handle or move a canister during testing.

4. Do not smoke around the canister.

5. To the extent possible, leave doors and windows closed during testing.

6. To the extent possible, do not use paint, solvents, glues, and spray cans during testing.

7. If possible, do not bring dry cleaning into the building during the testing.

8. We will be back tomorrow to pick up the canister about this time.

Canister pick up: Day________________________________

Time________________________________

Thank you for your cooperation.

ATTACHMENT C

SUB-SLAB SOIL VAPOR AND
INDOOR AIR SAMPLING ACTIVITIES

SUB-SLAB SOIL VAPOR AND INDOOR AIR SAMPLING ACTIVITIES

The objectives of the sub-slab soil gas sampling are as follows:

- Determine whether contaminant concentrations pose more than a 1×10^{-4} cancer risk or a hazard index (HI) greater than 1.0 through the vapor intrusion (VI) pathway to current or potential future receptors
- Determine whether concentrations of combustible gases within a structure exceed 10 percent of the lower Explosive Limit (LEL) for methane)
- Identify buildings where indoor air sampling is required based on the sub-slab sample results

Sub-slab soil vapor probes will be installed in accordance with the Vapor Intrusion Investigation Work Plan, dated December 17, 2010. Sub-slab soil vapor probes will be installed beneath the following existing on-Site structures:

A. *Structures On Site West of Dryden Road:*
3 building structures on Lot 5054
3 building structures on Lot 5171
2 building structures on Lot 5172
1 building structure on Lot 5174
1 building structure on Lot 5175, and

B. *Structures On Site or Adjacent to Site Along East River Road:*
4 building structures on Lot 4610 (Barnett; on-Site)
2 building structures on Lot 3207
1 residence on Lot 3253; and
1 building structure on Lot 3254.

Prior to conducting the sub-slab soil vapor sampling, CRA will visually inspect of the Lots in question and document the number and type of buildings present on each Lot in order to ensure that all buildings that are or may be occupied are included in the sampling program.

Prior to installing the sub-slab soil vapor probes, a survey will be conducted of each building, to identify potential preferential pathways for vapor migration under the building. Details of the building survey are included in the Vapor Intrusion Investigation Work Plan. If any structure on or adjacent to the Site that is or may be occupied has no slab (e.g., dirt or gravel floor), indoor air samples will be collected. For any location where an indoor air sample is collected, CRA will also install a soil vapor probe screened between 3 and 5 feet below ground surface in accordance with CRA's SOP [Appendix J-F-11 of the Field Sampling Plan (FSP)] in order to attempt to correlate indoor air concentrations to concentrations of contaminants in soil vapor near the structure. The soil vapor probes will be installed immediately adjacent to the side of the building closest to the most likely source of any soil vapor impacts. In addition, where indoor air samples are collected, CRA will also collect ambient air samples immediately adjacent to the structure as per CRA's SOP.

CRA's standard operating procedure (SOP) for installing sub-slab probes and collecting sub-slab vapor samples are in Attachment A to the Vapor Intrusion Investigation Letter Work Plan (addendum to the FSP). CRA's SOP for indoor air sampling is in Attachment B to the Vapor Intrusion Letter Work Plan (addendum to the FSP).

If collected, sub-slab soil gas samples will be analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), along with chlorinated VOCs including perchloroethylene (PCE), trichloroethylene (TCE), cis/trans-1,2-dichloroethylene (1,2-DCE), 1,1-dichloroethylene (1,1-DCE), and VC in accordance with the USEPA Toxic Organics-15 (TO-15) parameter list.